# Toward Understanding Differences Between GISS GCM Convective and Stratiform Rainfall and Diabatic Heating and GPM Retrievals

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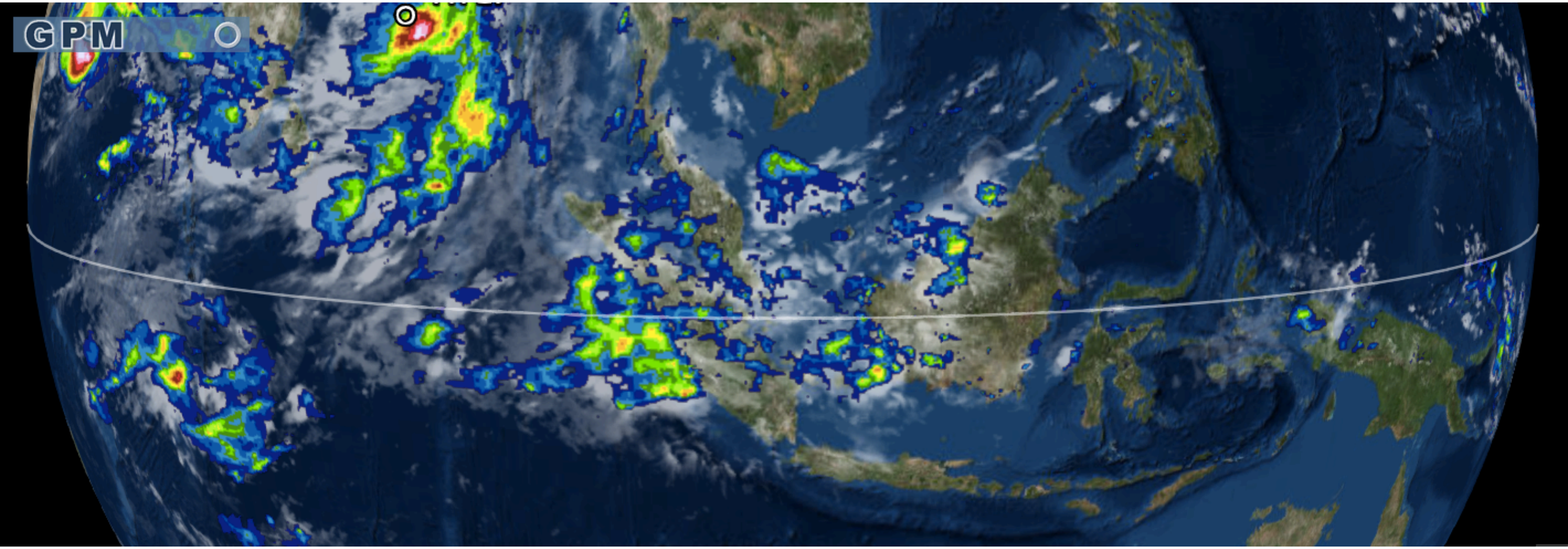


(thanks to Thomas Fiolleau and Rémy Roca)

National Aeronautics and Space Administration
**Goddard Institute for Space Studies**
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Columbia University
in the City of New York

# Organized mesoscale convection is central to Earth's climate

- Source of most stratiform tropical rainfall
- Controls the diurnal cycle of precipitation
- Controls tropical high cloud and radiation
- Shifts the diabatic heating profile and thus the general circulation

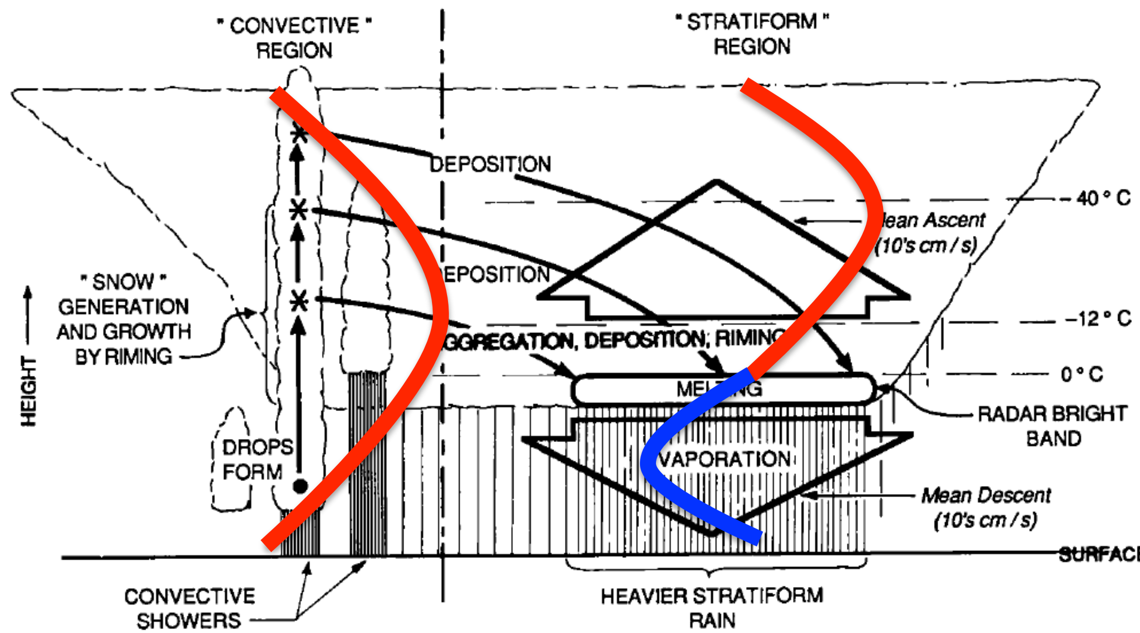
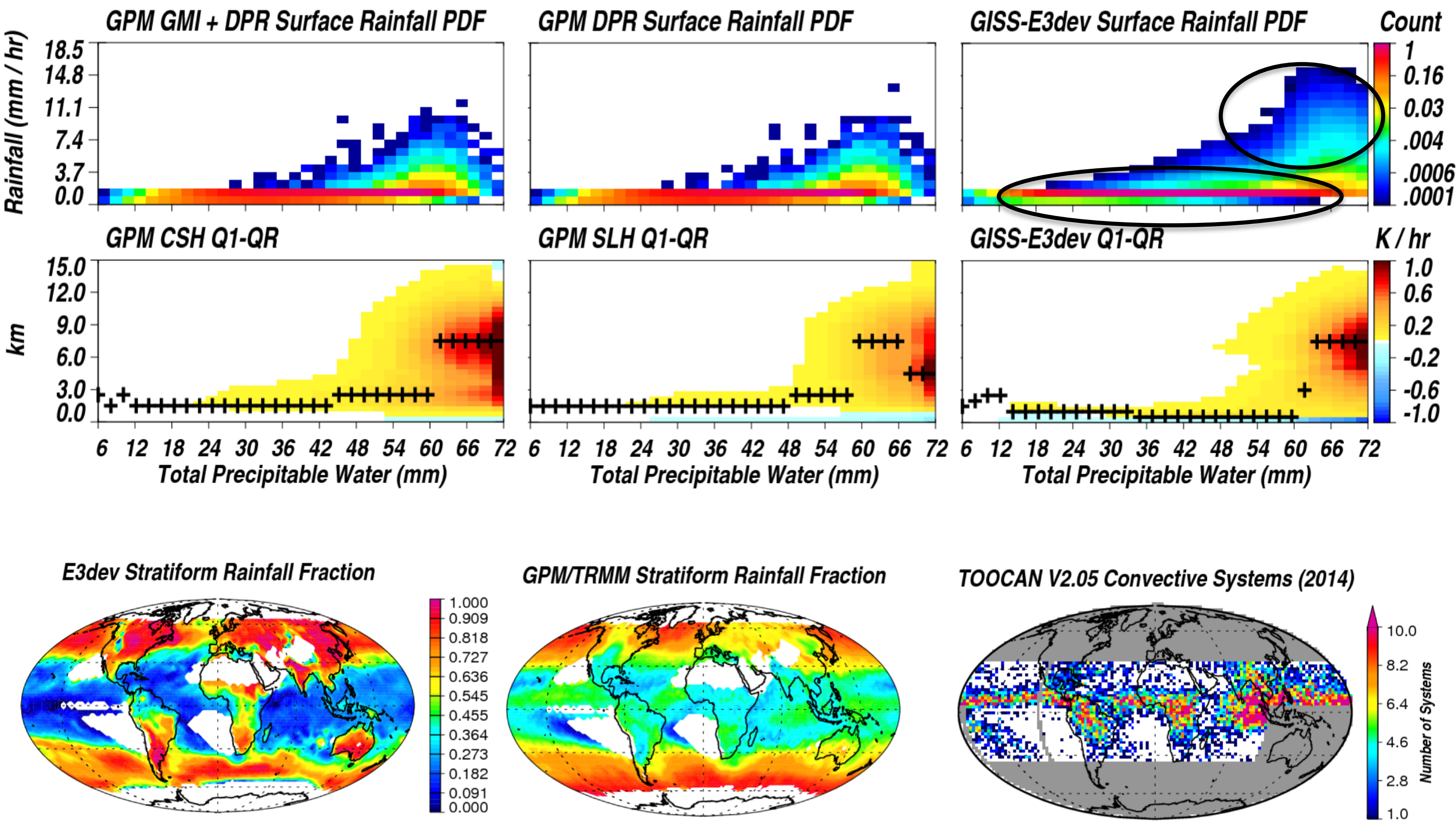



Figure 2. Schematic diagram of the precipitation mechanisms in a tropical cloud system. Solid arrows indicate particle trajectories (adapted from Houze 1989).

But no current CMIP GCM represents organized convection

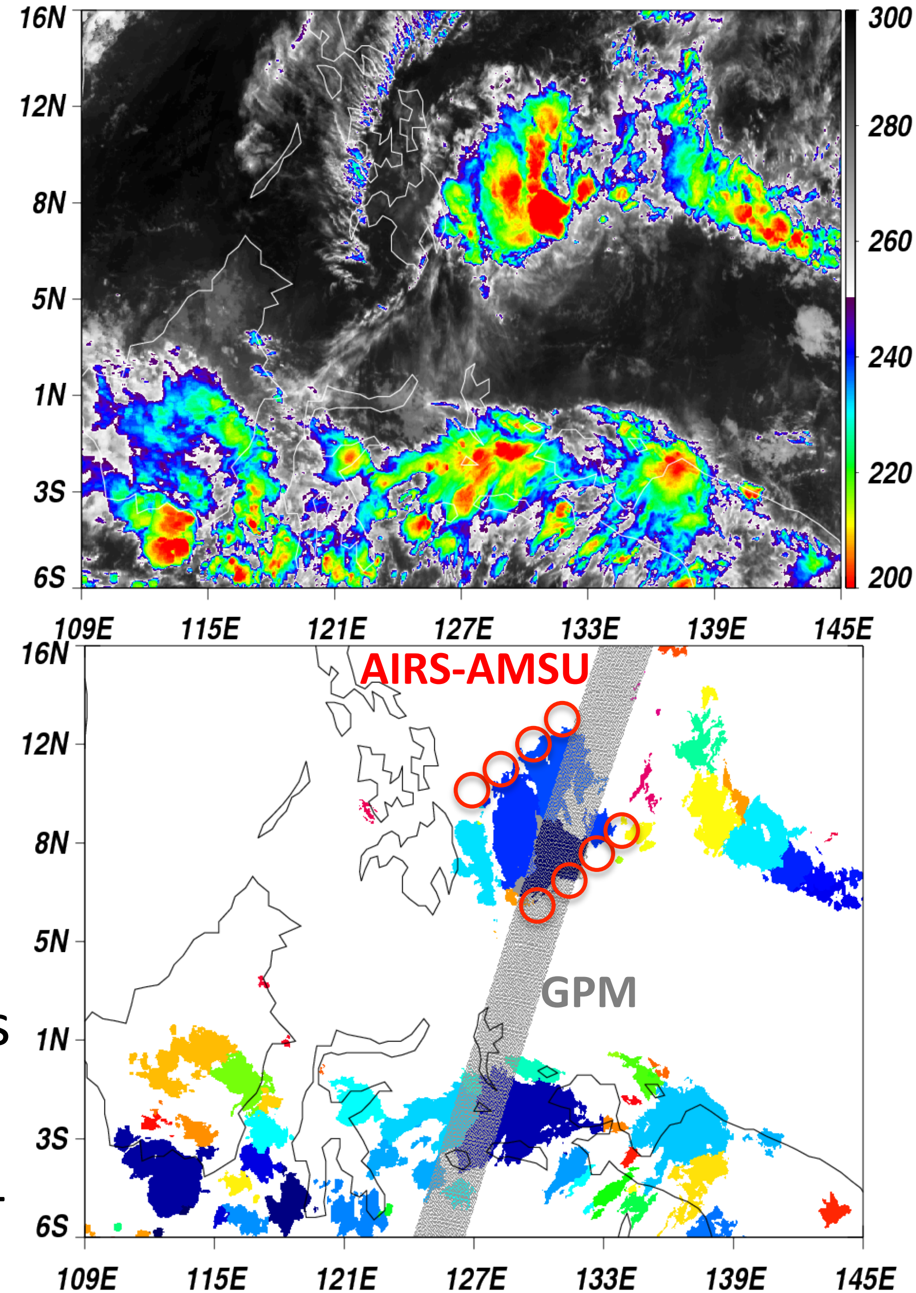
# GCM has too much heavy rain, too few non-raining areas, too little stratiform rain in tropics

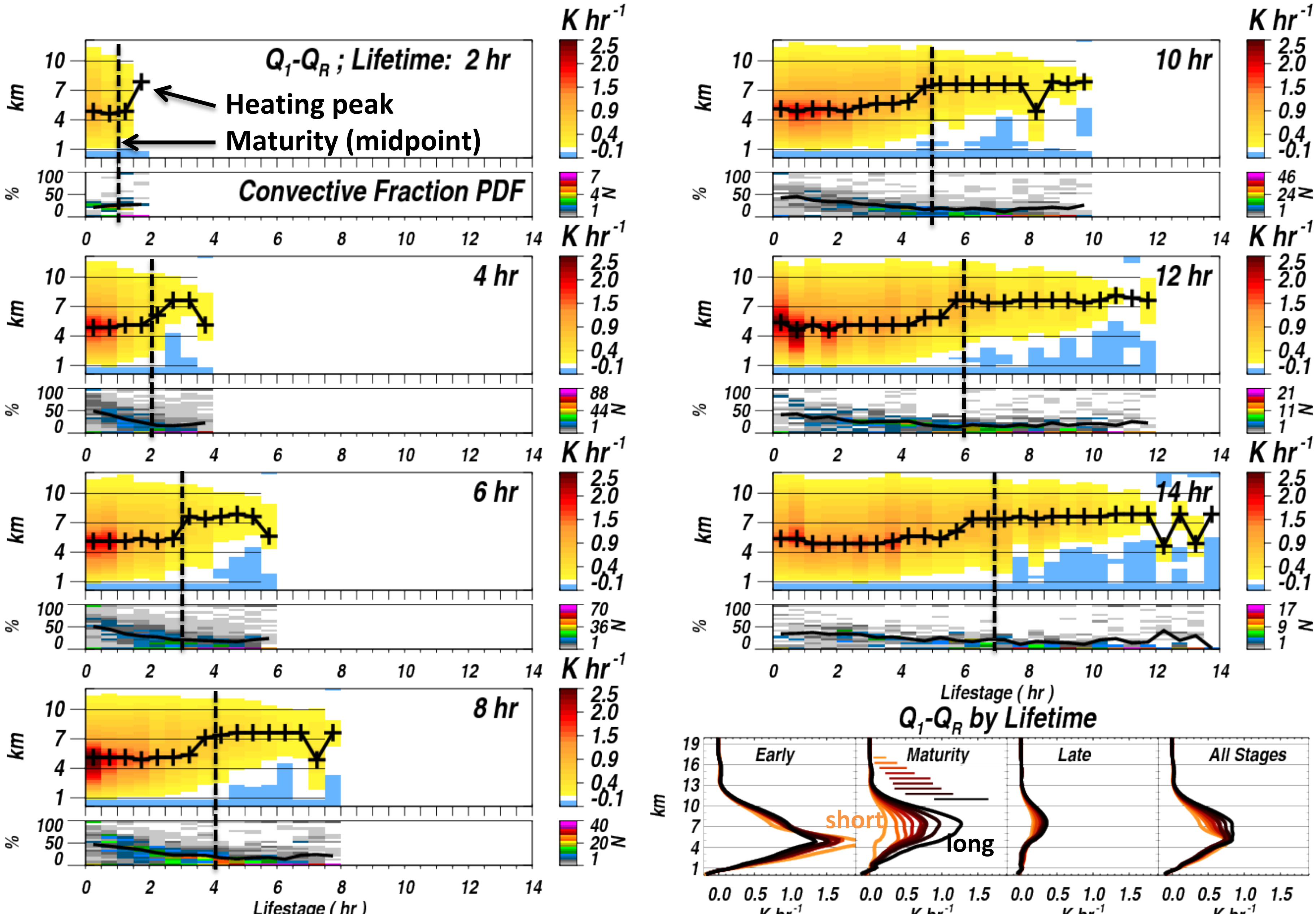


# Tropical MCS tracking, collocated GPM products + atmospheric state

- TOOCAN V2.05 convective system database (Fiolleau and Roca, 2013)
- GPM DPR V05 L2 convective fraction for overpasses of TOOCAN systems
- GPM V05 CSH and SLH $Q_1$-$Q_r$
- AIRS/AMSU T, q profiles adjacent to TOOCAN systems

~41,000 storms, 30N-30S, Mar.-Dec. 2014

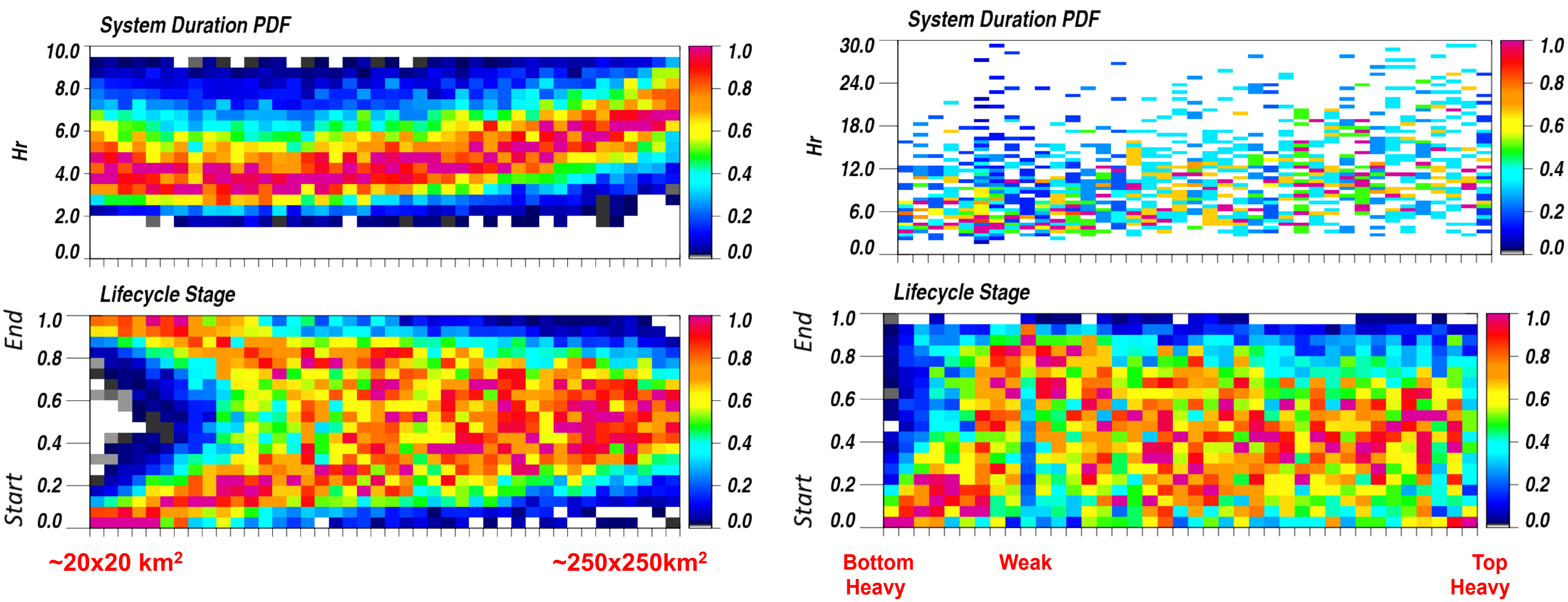





- Convective fraction decreases up to maturity
- Heating peak shifts up near maturity

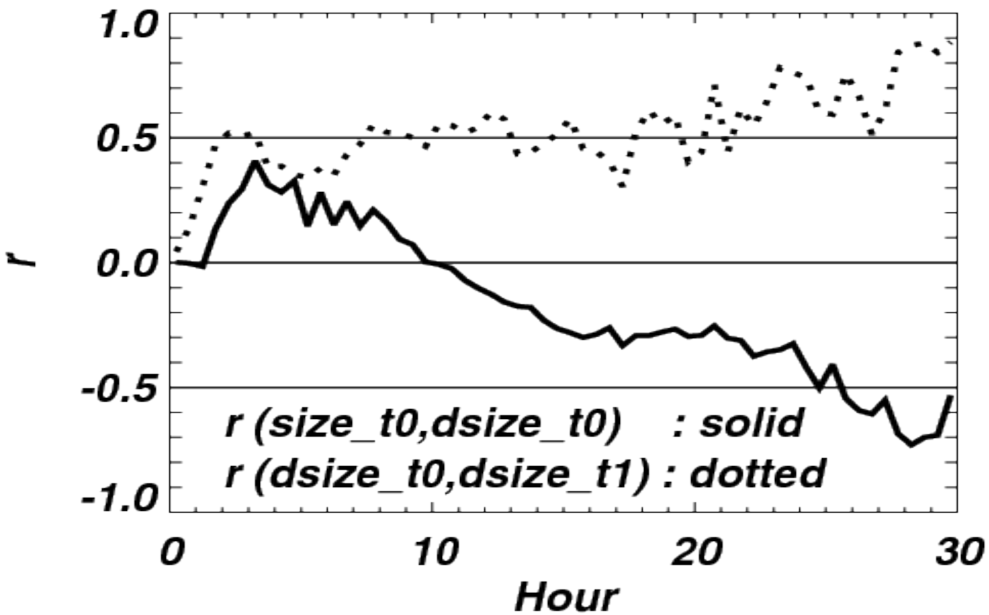
- Longer-lived systems have more top-heavy heating at maturity, and in mean

# Bigger systems tend to be longer-lived…

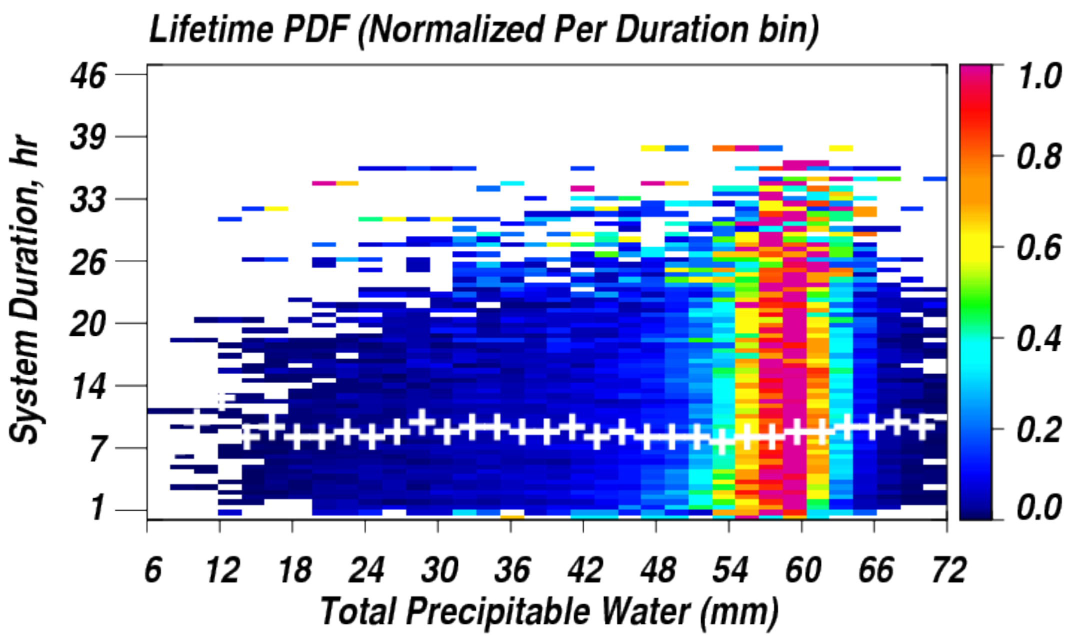



...but lots of variability in most everything else, so composites can be misleading

What determines the evolution of system size?



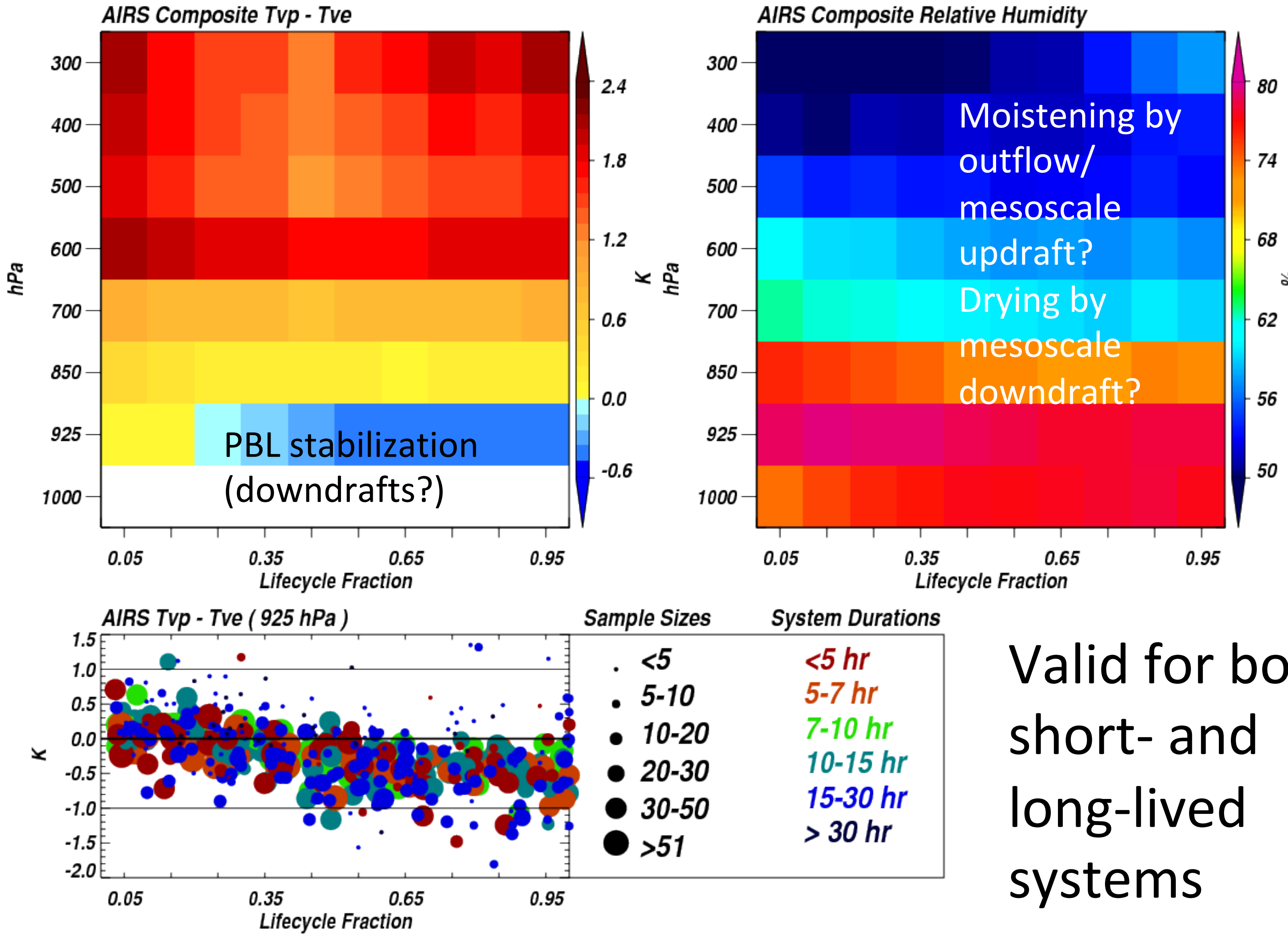

Current size is not a good predictor of future growth, and current growth is only a weak predictor of future growth




MCS *occurrence* is predicted well by TPW, but is unrelated to system duration

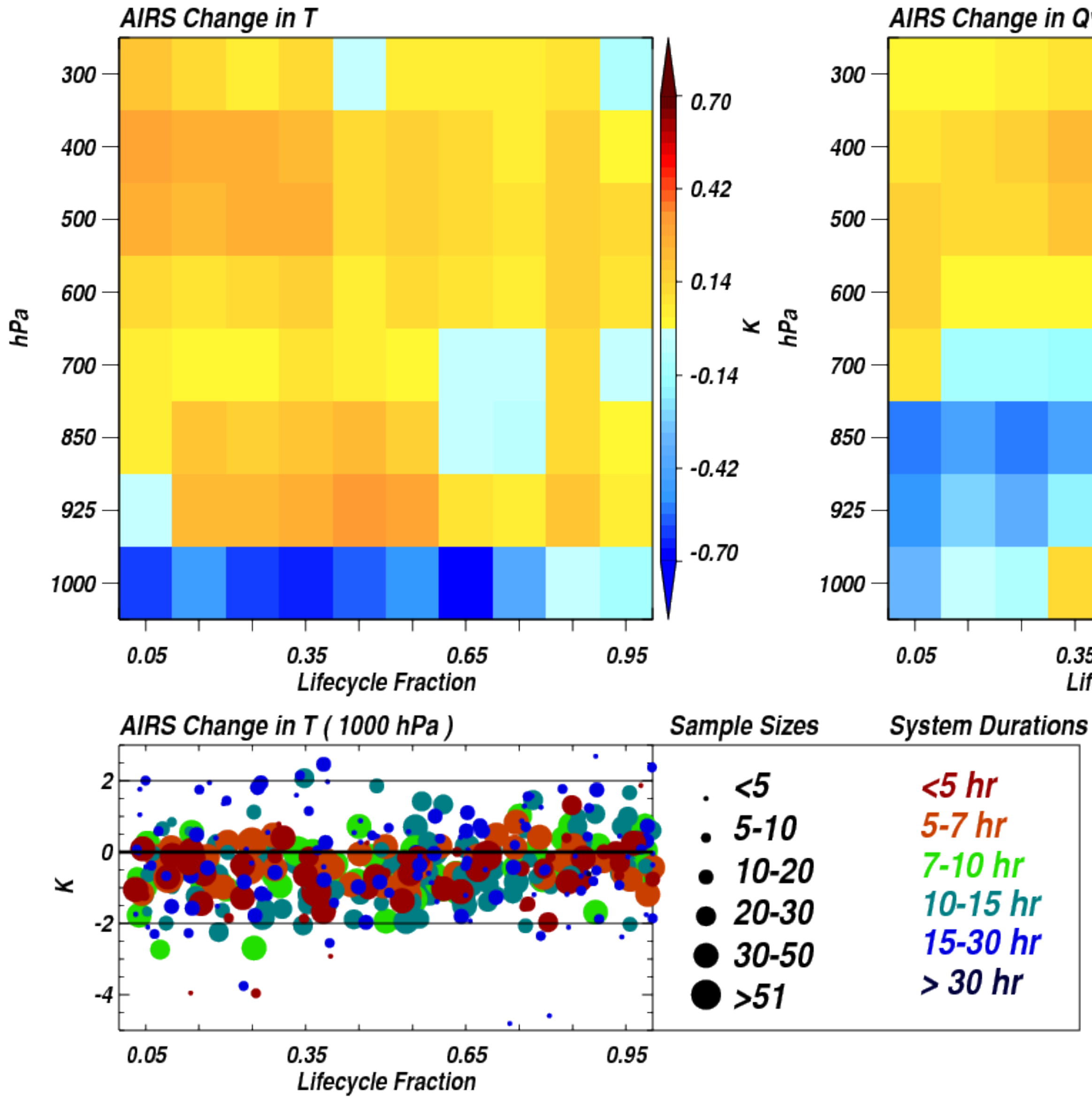
Are smaller scale environmental factors important?

# Do MCSs sow the seeds of their own destruction?




Valid for both short- and long-lived systems

# PBL cooler, drier after MCS passage than before




But not later in the lifecycle – cold pool recovery?

# Summary/speculations:

- Shift from bottom-heavy to top-heavy heating occurs near midpoint of MCS lifecycle (in composite sense)
- Longer lived systems have more top-heavy heating
- Other than bigger = longer-lived, no systematic relation between MCS duration and other MCS properties, even when composites suggest so
- But clear signs of PBL stabilization by convection − perhaps variability in MCS evolution is determined by the MCS itself (e.g., cold pool spread, upward stirring of cold ocean water) or by random changes in surface/PBL conditions along MCS path, e.g., by neighboring systems?